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# ECOLOGICAL IMPACT ON DENGUE FEVER - A VECTOR-BORNE ZOONOSES.

Medical Microbiology

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## ABSTRACT

The present study with a sample size of 239 collected from the month of September to November in a tertiary care hospital, the maximum turnout of patients for dengue testing was found in the month of September however maximum positive dengue cases were recorded in the month of October. Positive cases are more ( 35.29%)detected in female patients in comparison to male positive cases (29.20%)during the study period. More women(16.67%) used to get diagnosed( test sample) after at least one week from onset of infection in comparison to men (10 %) meaning thereby the priority for diagnosis is less seen in rural women folk. There is no dengue secondary infection found in 239 samples under study .There was no co- infection recorded with chickungunya out of 239 samples tested for dengue and chickungunya. Out of 239 total samples tested , 76 samples found positive(31.80%) with NS1 ,10 samples (4.18%%) found positive only with IgM antibody, Nil sample was found positive with IgG and 15(6.28%) cases are positive with NS1 and IgM both. We found declining trend of reporting of dengue cases after end of September month . It means as the weather temp. gets reduced ,the Dengue cases started declining. There is important angle to minimize contact of human species from animal species like pigs and rodents to control the transmission of dengue virus . Integrated research is needed for enzootic cycle with animals and further spilling of virus to human transmission .

## KEYWORDS

Zoonoses, Dengue fever, Ecology, vector-borne zoonoses, mosquito-borne viral disease, sylvatic dengue virus, Enzootic

**BACKGROUND-**

Dengue is a mosquito-borne viral disease and its transmission is closely linked to climate. In northern part of india , rainy season normally starts from june and end upto mid September. The established fact that mosquito play a vital role in transmission of disease and breeding of mosquito takes place in stagnant water which accumulates widely in rainy season. The hypothesis was to study reporting pattern of dengue cases starting from end of rainy season till the period it starts declining .Therefore the study for month wise prevalence of dengue cases from September to November brought to tertiary care hospital was carried out .The target population is rural orientation who have exposure to animals like pigs, rodents , bats and dogs in daily life therefore this animal segment may have contributory role as additional reservoir of dengue virus .There is a problem in testing of animals because of limited resources available. We have tried to find studies carried out on animals but only few research articles are available that too the positivity of dengue in animals was done by serological tests, not confirmed by RTPCR. One meta analysis authored by S.X.W. Gwee etal published in ELSEVIER ONE HEALTH Journal in 2021 (Title- Animals as potential reservoirs for dengue transmission: A Systematic Review - www.elsevier.com/locate/onehlt ) based on 3818 research articles review was considered authentic for this study .In this study , a total of 16,333 animals were tested, 1817 of which were positive for dengue virus by RT-PCR or serology. Dengue positivity was detected in bats (10.1%), non-human primates (27.3%), birds (11%), bovid (4.1%), dogs (1.6%), horses (5.1%),pigs (34.1%), rodents (3.5%), marsupials (13%) and other small animals (7.3%) in this meta analysis.

**Objectives of Study-**

We aimed to explore dengue fever prevalence in the post rainy season and to know its peak .The zoonotic angle in transmission of dengue. Gender wise, Month wise , separate and together positivity with NS1, IgM and IgG were part of the study. The reporting and positive case pattern are also the area of present study.

**Inclusion And Exclusion Criteria-**

Febrile patients brought to hospital are included in the study. Non consented patients and repeat samples were excluded from the study.

**Analysis of Data –**

Chi-square Test and Logistic Regression analysis is being used to analyze the data.

**INTRODUCTION-**

The transmission of Diseases between animals and humans are as old as history of mankind. More than 60% of infectious diseases in man are zoonotic **[1].** The ecology and distribution of vectors greatly influence the vector-borne zoonoses development and transmission. Not only this ,the vectors are often not dependent on the single host species, which means, that the vector-borne zoonoses have also often more host or reservoir species.That is why their dynamics is less predictable and elimination are more problematic **[2].** The environment conditions affect the Host, pathogen and vector substantially. According to The One Health Triad, there is a close relationship and interaction between human, animal and environmental health **[3].**

Zoonoses transmission and distribution is greatly affected by climatic change and human activities. Arthropod vectors are usually considerably sensitive to environmental changes and often have the key influence on the disease distribution. Since vectors are ectotherms, they are strongly affected by changes in temperature patterns of environment **[4,5]**. Higher temperatures support the development, survival and increasing density and a real expansion of ticks and mosquitoes **[6–9]**. The increase in temperature accelerate the pathogen replication and help in disease transmission [10]. These facts are in a correlation with the increase of vector-borne zoonoses incidence that has been reported recently and which has also been predicted by some climatic models for the near future **[6–8,11]**. More so the flood , storms and inundation affect on the vector density **[9].** Intensive agriculture and industry, excessive grazing, drying of wetlands and deforestation lead to landscape transformations. Changes in the vegetation cover and water management may affect local precipitation and temperature conditions and lead to consequent changes in the ecosystem. This affects plant and animal communities and consequently vector and disease distribution **[12,13].**

Dengue is the most rapidly spreading mosquito-borne viral disease since years. Transmission is most prominent in the tropical and subtropical regions of the world. At least 128 countries, including 36 previously dengue-free countries in temperate regions, with a total estimated population of 3.97 billion people are at risk of dengue outbreak **[14].** Dengue virus transmission has likely originated from sylvatic cycles maintained between susceptible non-human primates(NHPs) and Aedes mosquitoes in the forests of Asia**[15]** Spillover of sylvatic dengue virus can occur in both rural and urban areas as zones of emergence. Given the adaptability of sylvatic virus for the human host and documented past infections that resulted in severe clinical manifestations, this can potentially sustain the natural horizontal human to human transmission via Aedes aegypti and Aedes albopictus mosquitoes **[16,17].** Dengue virus has been known to infect NHPs such as monkey, which serves as an effcient amplifcation host for enzootic dengue transmission **[17,18,19].**

One meta analysis systematic review showed that NHPs (27.3%), pigs (34.1%; by serology only) and bats (13.5%; by serology only) are likely more vulnerable to dengue virus infection than the other animals reported in the literature**[20).** Dengue transmission is well-known to involve sylvatic (enzootic)cycle and urban endemic cycle which involve non-human primates in sylvatic habitat and humans in urban setting as reservoir hosts **[21],** In one of the study carried out in Rajasthan the results of the study suggests that in Rajasthan, owing to tendency of over storage of domestic water by the inhabitants, mosquito and vertically transmitted virus get pronounced during summer season which could precedes the active transmission season of dengue during following rainy season.**[22]** Warm temperatures and high humidity favor increased longevity of the adult mosquitoes and shorten the viral incubation period within the vector and its blood-feeding intervals, thus leading to faster virus replication and increased transmission intensity.**[23]**The association between weather and dengue varies across geographical locations and socio-environmental strata.**[24,25]**

**Dengue Positivity in Animals-**

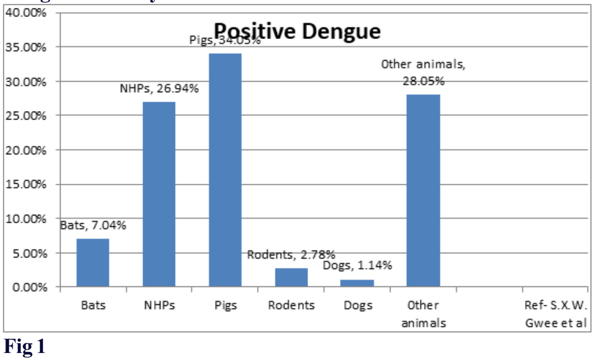


**Fig 1**

The above figure is based on meta analysis and publication by S.K.W.et al . As per this study 11.1% animals were found dengue positive which may serve as reservoir for dengue transmission. Amongst animals , Pigs contribute 34.05% dengue infection followed by bats rodents and dogs.**( Ref. Fig 1)**

**MATERIALS AND METHODS-**

**Serology And Microscopy-**Serum samples from clinically suspected patients having a history of fever since almost a week were tested for NS1 antigen . Those having fever for more than a week were also tested for dengue-specific IgM antibodies by using IgM antibody capture enzyme-linked immunosorbent assay (MAC-ELISA) kit . All samples were also tested with IgG together with NS1 and IgM to ascertain secondary infection. The sample timing and the need for using dengue specific antigen NS1 and both the antibodies (IgM and IgG) are very important criteria that will widen diagnostic horizon. When these tests are performed together the status of a dengue patient can be precisely diagnosed in a laboratory set up helping to treat and monitor the patient. Sample tested with NS1 antigen usually be demonstrated from the very beginning of dengue fever. Here lies its importance. It will help immensely to monitor dengue from its early stage. On the other hand, IgM antibodies will appear in the blood of a dengue patient at least after 4-5 days of the onset of fever.

**Dengue Co-infections-**

we find Nil coinfection with chickungunya in 239 samples under present study.

**Study population/ sample size-**

Rural patients with febrile history brought to tertiary care hospital. The sample size of the study was 239.

**RESULTS-**

**Table 1- Month Wise Distribution Of Dengue Cases –**

| Month/ Year | Total sample tested (No.) | Positive sample with NS1(No.) | Positive sample with IgM(No.) | Positive sample with IgG(No.) | Total positive sample( No.) | % positive sample (No.) |
|---|---|---|---|---|---|---|
| Sept.2023 | 106 | 11 | 12 | 00 | 23 | 21.69 |
| Oct. 2023 | 86 | 28 | 07 | 00 | 35 | 40.69 |
| Nov. 2023 | 47 | 14 | 04 | 00 | 18 | 38.29 |
| Total | 239 | 53 | 23 | 00 | 76 | 31.8 |

**Remarks –** Reporting of Dengue cases are 106 in September ,86 in October and 47 in November month.The maximum positive cases(40.69%) are detected in the month of October followed by 38.29% in November and least (21.69% )in September month. There is no secondary infection found in 239 samples under study.

**Table 2- Gender –wise positive cases of Dengue –**

| Month/ Year | Male total sample tested (No.) | Male positive sample ( No.) | % positive Male | Female Total sample tested (No.) | Female positive sample (No.) | % Positive Female |
|---|---|---|---|---|---|---|
| Sep. 2023 | 64 | 16 | 25.00% | 42 | 09 | 21.42% |
| Oct. 2023 | 44 | 17 | 38.63% | 41 | 18 | 43.90% |
| Nov. 2023 | 29 | 07 | 24.13% | 19 | 09 | 47.36% |
| Total | 137 | 40 | 29.20% | 102 | 36 | 35.29% |

**Remarks-** Positive cases are more ( 35.29%)detected in female patients in comparison to male positive cases (29.20%).November month has recorded highest (47.36%) positive cases in female patients whereas maximum male patients (38.63%)were found positive in the month of october .The lowest positive (24.13%) in male patients recorded in November whereas lowest positive (21.42%) in female patients recorded in September .

**Table 3-Distribution of positive Dengue cases by IgM alone –**

| Month/ Year | Male Positive cases ( No.) | Male positive detected only by IgM (No.) | % Male positive only by IgM | Female positive cases (No.) | Female positive detected only by IgM (No.) | % Female positive only by IgM |
|---|---|---|---|---|---|---|
| Sep.2023 | 16 | 03 | 18.75% | 09 | 04 | 44.44% |
| Oct. 2023 | 17 | 01 | 5.88% | 18 | 02 | 11.11% |
| Nov 2023 | 07 | 00 | 00.00 | 09 | 00 | 00% |
| Total | 40 | 04 | 10.00 % | 36 | 06 | 16.67% |

**Remarks-** More women used to get diagnosed( test sample) after one week approx.( 16.67%) from onset of Dengue infection in comparison to men ( 10.00%). Meaning thereby the priority for diagnosis is less seen in rural women folk than male patients.

**Table 4- Dengue Cases Reporting Pattern During Months Of Study-**

| Month/Year | Male patients ( No.) | Female patients (No.) | Total Patients ( No.) | Month-wise % of Reporting to total reporting |
|---|---|---|---|---|
| Sep. 2023 | 64 | 42 | 106 | 44.35% |
| Oct. 2023 | 44 | 41 | 85 | 35.57% |
| Nov. 2023 | 29 | 19 | 48 | 20.08% |
| Total | 137 | 102 | 239 | 100% |

**Remarks-** There is declining trend of Dengue cases after end of Sept. month . It means as the weather temp. gets reduced ,the Dengue cases start declining.44.35% cases are reported in September ,35.57% were recorded in October and 20.08% cases are reported in November month.

**Table 5- Pattern Of Dengue Positive Cases –**

| Month/Year | Male positive (No.) | Female positive (No.) | Total positive cases (No.) | % Positive cases |
|---|---|---|---|---|
| Sept. 2023 | 16 | 09 | 25 | 32.89% |
| Oct. 2023 | 17 | 18 | 35 | 46.06% |
| Nov. 2023 | 07 | 09 | 16 | 21.05% |
| Total | 40 | 36 | 76 | 100.00% |

**Remarks** - Though maximum reporting of Dengue cases (106) was recorded in the month of Sept. But the maximum positive cases (35 out of 76 ) were detected in the month of October .

**Table 6- Distribution Of Positive Dengue Cases Found Reactive To Both NS1 Antigen And IgM Antibody.**

| Month/ Year | Total male positive sample (No.) | Male positive for both (No.) | % male positive by both | TotalFemale positive sample (No.) | Female positive by both (No.) | % female positive |
|---|---|---|---|---|---|---|
| Sept. 2023 | 16 | 04 | 25% | 09 | 01 | 11.11% |
| Oct. 2023 | 17 | 04 | 23.52% | 18 | 03 | 16.67% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Nov. 2023 | 07 | 01 | 14.28% | 09 | 02 | 22.22% |
| Total | 40 | 09 | 22.50% | 36 | 06 | 16.66% |

**Remarks-** NS1 antigen should be found in the blood of dengue patients up to 9 days of the onset of fever **[30].** It means 09 ( 22.50%) male positive dengue patients were suffering from approximately 9days where both NS1 antigen and IgM antibody found positive . In case of female 06 ( 16.66%) positive cases were found positive by both antigen and antibody tests. Overall 15 positive cases out of 76 positive cases( 19.74% ) have been found positive for both antigen and antibody but did not record any case reactive to IgG means no secondary infection found .

## DISCUSSION-

In the present study where samples are collected from mostly rural area. The main profession of this locality is agriculture and animal husbandry . Though we could not study the animal transmission route of dengue but it appears certain that the animals like pigs and rodents are also playing a vital role in transmission of dengue fever.

It is also observed in the present study that the maximum dengue cases are reported in post rainy season . The peak is in October month . The cases starts declining from the month of November. The study confirms that peak of dengue cases are detected after rainy season because of stagnant water provide congenial atmosphere for mosquito breeding.

A recent study has compiled all dengue outbreaks in India,showing that most dengue outbreaks occurred in Punjab, Haryana,Rajasthan, Gujarat and Kerala states during the monsoon or post-monsoon period. Thus, all study states the transmission of virus are influenced by strong seasonality, the role of rainfall and ambient temperature during monsoon and post-monsoon periods. Further studies are required to develop seasonal forecasting of dengue incidence in India**.[26,27]**

In one study carried out in KGMU Lucknow , it was observed that Cases of dengue fever started increasing in the last week of June or early July every year and reached at peak during August to October . Rainy season in Lucknow starts around late June and lasts till October. A seasonal peak of DV infection was recorded around 4-6 wk after arrival of rain every year**.[28]** The distribution of dengue cases across the monsoon and post-monsoon seasons of the study years showed remarkable differences in the prevalence of infection which is statistically significant (chi squared value 15.54; $p < 0.05$). The peak in dengue positivity was observed in October of 2012 and 2014 and in September of alternate years 2013 and 2015. During the pre monsoon season from January to June over a period of four years, only three dengue cases were reported**.[29**]

## CONCLUSION-

From the above results based on three months study , we can safely arrive at the conclusion that Dengue cases starts from JULY month on onset of rainy season and reach to the peak by the month of October and gets declining from the month of November in northern India. It is also established during study that women are found reluctant for early diagnosis of disease in rural area. The percentage of male positive patients with delayed testing is less(10 % ) than that of female positive patients (16.67%).There is strong recommendation to work on animal cycle of dengue and its management for improving strategy to deal with the disease in more effective manner.

### Conflict Of Interest-

No potential conflict of interest was reported by the author.

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